

WHAT IS CLAIMED IS:

1. A computer-implemented method for evaluating a process margin comprising:

5        setting a plurality of setting values of a light exposure and a plurality of setting values of a focus position in an exposure process for forming a pattern on a substrate to be exposed to light;

             calculating a plurality of pseudo measured dimensions  
10 of the pattern with respect to each combination of the setting values of the light exposure and the setting values of the focus position;

             calculating a plurality of ED-trees and calculating a plurality of margin curves based on the pseudo measured  
15 dimensions with respect to each of the combinations; and

             calculating a dispersion of a tolerance of the light exposure of the margin curves at a depth of focus corresponding to a maximum difference in height of the substrate.

20 2. The computer-implemented method as claimed in claim 1, wherein a measured dimension of the pattern has a dimensional dispersion, and the calculating of the pseudo measured dimensions includes:

             calculating a calculated dimension of the pattern  
25 with respect to each of the combinations;

generating a plurality of dimension random numbers having the dimensional dispersion with respect to each of the combinations; and

calculating the plurality of the pseudo measured  
5 dimensions obtained by adding the dimension random numbers to the calculated dimension with respect to each of the combinations.

3. The computer-implemented method as claimed in claim 1, wherein an effective value of the light exposure has a  
10 light exposure dispersion and an effective value of the focus position has a position dispersion, and the calculating of the pseudo measured dimensions includes:

generating a plurality of light exposure random numbers having the light exposure dispersion with respect  
15 to each of the combinations;

calculating a plurality of pseudo light exposures obtained by adding the light exposure random numbers to the setting values of the light exposure with respect to each of the combinations;

20 generating a plurality of position random numbers having the position dispersion with respect to each of the combinations;

calculating a plurality of pseudo focus positions obtained by adding the position random numbers to the  
25 setting values of the focus position with respect to each

of the combinations; and

calculating the calculated dimension of the pattern based on the pseudo light exposure and the pseudo focus position with respect to each of the combinations, so as to  
5 calculate the pseudo measured dimensions.

4. The computer-implemented method as claimed in claim 1, wherein the setting values of one of the light exposure and logarithms of the setting values of the light exposure are set at a constant interval, and the setting values of the  
10 focus position are set at a constant interval.

5. A computer-implemented method for setting up a measurement condition of a process margin comprising:

setting a plurality of setting values of a light exposure at equal first intervals and setting a plurality  
15 of setting values of a focus position at equal second intervals in an exposure process for forming a pattern on a substrate to be exposed to light;

calculating a plurality of pseudo measured dimensions of the pattern with respect to each combination of the  
20 setting values of the light exposure and the setting values of the focus position;

calculating a plurality of ED-trees and calculating a plurality of margin curves based on the pseudo measured dimensions with respect to each of the combinations;

25 calculating a dispersion of a tolerance of the light

exposure of the margin curves at a depth of focus  
corresponding to a maximum difference in height of the  
substrate; and

reducing one of the first interval and the second  
5 interval so as to reduce the dispersion of the tolerance of  
the light exposure while increasing one of the first  
interval and the second interval so as to increase the  
dispersion of the tolerance of the light exposure.

6. The computer-implemented method as claimed in claim 5,  
10 wherein a measured dimension of the pattern has a  
dimensional dispersion, and the calculating of the pseudo  
measured dimensions includes:

calculating a calculated dimension of the pattern  
with respect to each of the combinations;

15 generating a plurality of dimension random numbers  
having the dimensional dispersion with respect to each of  
the combinations; and

calculating the plurality of the pseudo measured  
dimensions obtained by adding the dimension random numbers  
20 to the calculated dimension with respect to each of the  
combinations.

7. The computer-implemented method as claimed in claim 5,  
wherein an effective value of the light exposure has a  
light exposure dispersion and an effective value of the  
25 focus position has a position dispersion, and the

calculating of the pseudo measured dimensions includes:

generating a plurality of light exposure random numbers having the light exposure dispersion with respect to each of the combinations;

5        calculating a plurality of pseudo light exposures obtained by adding the light exposure random numbers to the setting values of the light exposure with respect to each of the combinations;

generating a plurality of position random numbers  
10    having the position dispersion with respect to each of the combinations;

calculating a plurality of pseudo focus positions obtained by adding the position random numbers to the setting values of the focus position with respect to each  
15    of the combinations; and

calculating the calculated dimension of the pattern based on the pseudo light exposure and the pseudo focus position with respect to each of the combinations, so as to calculate the pseudo measured dimensions.

20    8.    A computer program product to be executed by a computer for evaluating a process margin comprising:

instructions configured to set a plurality of setting values of a light exposure and a plurality of setting values of a focus position in an exposure process for  
25    forming a pattern on a substrate to be exposed to light;

instructions configured to calculate a plurality of pseudo measured dimensions of the pattern with respect to each combination of the setting values of the light exposure and the setting values of the focus position;

5           instructions configured to calculate a plurality of ED-trees and configured to calculate a plurality of margin curves based on the pseudo measured dimensions with respect to each of the combinations; and

          instructions configured to calculate the dispersion  
10 of the tolerance of the light exposure of the margin curves at a depth of focus corresponding to a maximum difference in height of the substrate.

9.       The computer program product as claimed in claim 8, wherein a measured dimension of the pattern has a  
15 dimensional dispersion, and the instructions configured to calculate the pseudo measured dimension include:

          instructions configured to calculate a calculated dimension of the pattern with respect to each of the combinations;

20           instructions configured to generate a plurality of dimension random numbers having the dimensional dispersion with respect to each of the combinations; and

          instructions configured to calculate the plurality of the pseudo measured dimensions obtained by adding the  
25 dimension random numbers to the calculated dimension with

respect to each of the combinations.

10. The computer program product as claimed in claim 8,  
wherein an effective value of the light exposure has a  
light exposure dispersion and an effective value of the  
5 focus position has a position dispersion, and the  
instructions configured to calculate the pseudo measured  
dimensions include:

instructions configured to generate a plurality of  
light exposure random numbers having the light exposure  
10 dispersion with respect to each of the combinations;

instructions configured to calculate a plurality of  
pseudo light exposures obtained by adding the light  
exposure random numbers to the setting value of the light  
exposure with respect to each of the combinations;

15 instructions configured to generate a plurality of  
position random numbers having the position dispersion with  
respect to each of the combinations;

instructions configured to calculate a plurality of  
pseudo focus positions obtained by adding the position  
20 random numbers to the setting value of the focus position  
with respect to each of the combinations; and

instructions configured to calculate the calculated  
dimension of the pattern based on the pseudo light exposure  
and the pseudo focus position with respect to each of the  
25 combinations, so as to calculate the pseudo measured

dimensions.

11. The computer program product as claimed in claim 8,  
wherein the setting values of one of the light exposures  
and logarithm of the setting values of the light exposure  
5 are set at a constant interval, and the setting values of  
the focus positions are set at a constant interval.

12. A computer program product to be executed by a  
computer for setting a measurement condition of a process  
margin comprising:

10 instructions configured to set a plurality of setting  
values of a light exposure at equal first intervals and  
setting a plurality of setting values of a focus position  
at equal second intervals in an exposure process for  
forming a pattern on a substrate to be exposed to light;

15 instructions configured to calculate a plurality of  
pseudo measured dimensions of the pattern with respect to  
each combination of the setting values of the light  
exposure and the setting values of the focus position;

instructions configured to calculate a plurality of  
20 ED-trees and calculating a plurality of margin curves based  
on the pseudo measured dimensions with respect to each of  
the combinations;

instructions configured to calculate a dispersion of  
a tolerance of the light exposure of the margin curves at a  
25 depth of focus corresponding to a maximum difference in



height of the substrate; and

instructions configured to reduce one of the first interval and the second interval so as to reduce the dispersion of the tolerance of the light exposure while  
5 configured to increase one of the first interval and the second interval so as to increase the dispersion of the tolerance of the light exposure.

13. The computer program product as claimed in claim 12, wherein a measured dimension of the pattern has a  
10 dimensional dispersion, and the instructions configured to calculate the pseudo measured dimension include:

instructions configured to calculate a calculated dimension of the pattern with respect to each of the combinations;

15 instructions configured to generate a plurality of dimension random numbers having the dimensional dispersion with respect to each of the combinations; and

instructions configured to calculate the plurality of the pseudo measured dimensions obtained by adding the  
20 dimension random numbers to the calculated dimension with respect to each of the combinations.

14. The computer program product as claimed in claim 12, wherein an effective value of the light exposure has a light exposure dispersion and an effective value of the  
25 focus position has a position dispersion, and the

instructions configured to calculate the pseudo measured dimensions include:

instructions configured to generate a plurality of light exposure random numbers having the light exposure dispersion with respect to each of the combinations;

instructions configured to calculate a plurality of pseudo light exposures obtained by adding the light exposure random numbers to the setting value of the light exposure with respect to each of the combinations;

instructions configured to generate a plurality of position random numbers having the position dispersion with respect to each of the combinations;

instructions configured to calculate a plurality of pseudo focus positions obtained by adding the position random numbers to the setting value of the focus position with respect to each of the combinations; and

instructions configured to calculate the calculated dimension of the pattern based on the pseudo light exposure and the pseudo focus position with respect to each of the combinations, so as to calculate the pseudo measured dimensions.